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International Cloud Week

THE International Survey of the Sky arranged by the Office National Météorologique de France took place from September 24th to 30th. The hours for taking photographs were 7, 13, and 18. The survey had originally been fixed for a week earlier, but was put off owing to the fact that the Meteorological Conference at Utrecht only ended on the 15th. The effect of this was that the evening hour was worse for photography than it would have been in the previous week. The sun was below the horizon and those who kept strictly to the scheduled hours had a good many blank plates if they exposed them at all at 18h. At Stoner Hill only one evening gave any cloud photographs.

The original propaganda included notices in photographic and scientific journals and many notices in the daily press; circulars were sent to meteorological stations and astronomical observatories; appeals were also kindly made by the British Broadcasting Company on two occasions. About 160 persons wrote to say that they would take part or to ask for further information, but the majority of these did not take any further action. Up to the present time photographs have been received from 56 stations, and 1,519 prints have been sent in.

The week was disappointing from a cloud point of view. The most interesting day was the first when there was a great amount of high cloud over a large part of England; at 7h. over the whole of the southern half of England there was much cirrus, which later in the day gave place to cirro cumulus, but on the subse-

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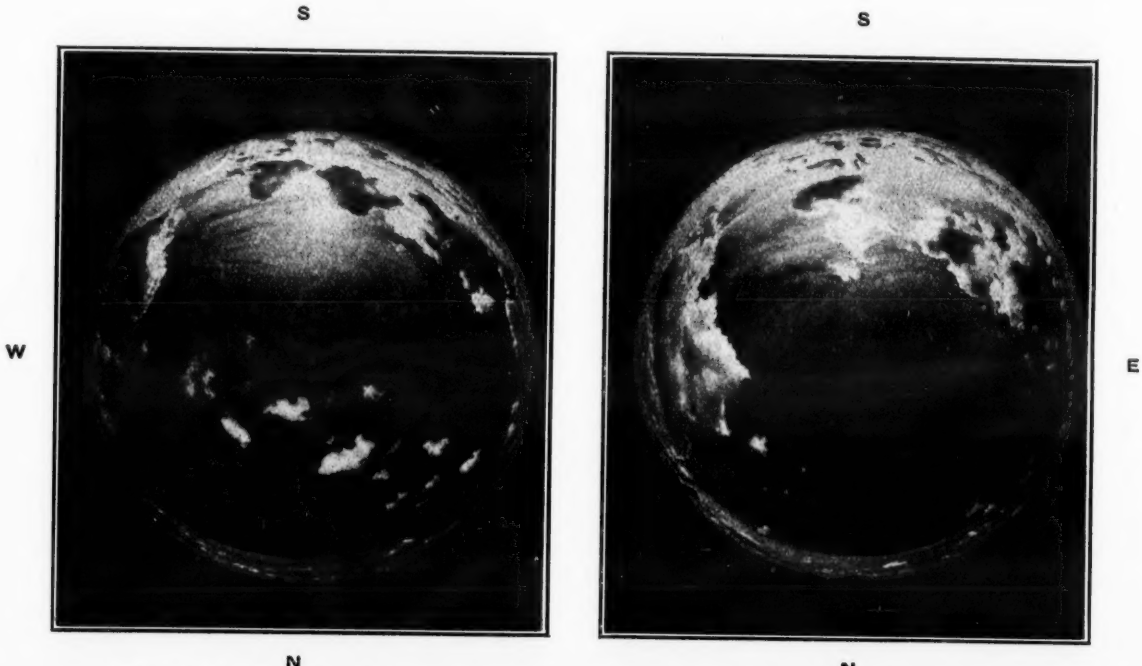
quent days the chief cloud forms were cumulus and strato-cumulus. Very low cloud interfered with photography on several occasions.

On the whole the prints sent in leave a good deal to be desired; those who have not taken up cloud photography find a good deal of difficulty at first in getting the right exposure and development; and even with Mr. G. Aubourne Clarke's excellent instructions, which were forwarded to all volunteers, it was only to be expected that photographers new to the cloud technique should not be very successful. Nevertheless, most of the photographs which failed in this way to make good pictures showed the cloud forms and therefore are useful. There is no doubt that the best photographs were taken by those who used colour filters. Even in the hands of experts, photographs of high clouds taken without filters showed little detail compared with those taken with filters; the best results were obtained with deep yellow or with red screens. One photographer, an expert it is true, had never before used panchromatic plates and colour filters, but in spite of using a process new to him his results were excellent. Some of those who did not use filters got good results in the evening, for when the sunlight passes through a great thickness of the atmosphere the latter in some measure takes the place of a filter.

It was suggested that at each of the hours five photographs should be taken, one each with the camera pointing north, east, south, west, and to the zenith; this, however, was only thrown out as a suggestion to be adopted by those who were so inclined, but it could hardly be expected that many volunteers would use as many as 105 plates in the week. The largest number of prints sent in were 120 from Mr. C. P. Butler, of the Solar Physics Observatory, Cambridge; 105 from the Royal Naval School of Photography, Portsmouth; 86 from Miss A. M. Bulkeley, St. Agnes, Cornwall; 82 from Mr. Alfred Moore, Lyndhurst, Hants.; 81 from Dr. Lockyer, the Norman Lockyer Observatory, Sidmouth; 75 from Mr. G. S. Sansom, Milford, Surrey. Good series were also sent in from the Royal Observatory, Greenwich; Mr. G. A. Clarke, Aberdeen; Mr. C. Leaf, Cambridge; Colonel Arthur Hill, Selham, Sussex; Mr. Wilfrid Hall, Hepplewoodside, Northumberland. Special mention must be made of a series of 37 prints sent by Mr. Robin Hill, of Cambridge, who photographed the whole sky from zenith to horizon on one plate (see Figs. I. & II.). The two photographs reproduced were taken at about 13h. on the 24th, four minutes elapsing between the first and second photograph; they show the bands of cirrus which were the feature of the day. Seven sets of photographs were received from London, five from Hampshire, four each from Hertfordshire and Surrey, three each from Cambridgeshire and Lancashire,



Figs. 1 & 2.—Whole Sky Photographs, Cambridge, Sept. 24th, 1923, about 13h. Interval 4 mins.

To face page 222.

two each from Cheshire, Cornwall, Devonshire, Kent, Middlesex, Nottinghamshire, and Sussex, and one each from Bedfordshire, Buckinghamshire, Derbyshire, Dorsetshire, Durham, Northumberland, Somersetshire, Worcestershire, and Yorkshire; three from Scotland, and one each from Wales, Ireland, Malta, and Blue Hill, U.S.A.

The Office National Météorologique will publish a short summary of the Survey, which will be sent to all those who supplied photographs, but this will probably not be ready for some time. The whole work of investigating the prints will take a long time, and it is estimated that it will be quite a year before the full scientific results are worked out.

Recent Researches on the Constituents of the Upper Atmosphere

By M. T. SPENCE, B.Sc.

IN the absence of direct observation, much consideration and discussion have been given to the nature of the gases in the upper strata of the atmosphere, more particularly since the spectrum of the aurora and the systematic observation of luminous meteors have provided indirect evidence on which tentative conclusions have been based. During the past few years notable contributions to the subject have been made by Chapman,* Milne,* Lindemann,† Dobson,†‡ Rayleigh,§ and Vegard.¶ Chapman and Milne calculated the composition of the atmosphere at various heights and concluded that up to 110 km. nitrogen composed more than half the atmosphere, but that at greater heights nitrogen became less predominant until at about 200 km. helium alone existed. They arrived at these conclusions by assuming—

1. That there is little or no hydrogen in the atmosphere.
2. That large-scale mixing effectively ceases at about 20 km. and that above this height the constitution of the atmosphere is determined solely by molecular diffusion.
3. That above the troposphere the temperature remains approximately constant to great heights (temperature about 220°A).

* *Q. J. R. Met. Soc.* vol. xlvi, 1920, p. 357.
† *London Proc. R. Soc.* vol. cii., 1923, p. 411.
‡ *Q. J. R. Met. Soc.* vol. xlix, 1923, p. 152.
§ *London Proc. R. Soc.* vol. ci., 1922, p. 114.
¶ *Phil. Mag.* vol. xlvi., 1923, p. 193.

The first assumption was based on experimental determinations of the presence of hydrogen near the earth's surface which showed that it was present only to a very small extent. If the hydrogen present were generated from the earth, it would most probably combine with oxygen through the action of lightning and possibly of sunlight before it had reached any great heights. The second assumption was based on the fact that there is little or no convective motion in the stratosphere. The third assumption was indicated by registering balloons, which have always shown an appreciably constant temperature in the stratosphere up to the greatest heights reached (37 km.).*

Lindemann and Dobson concluded from observations of the heights, paths and velocities of meteors that—

(A) Above 60 km., where there are numerous observations, the air densities, calculated from observations on meteors, are much higher than would be expected from computations based on the theory of molecular diffusion, and the lapse rate indicates a temperature much above 220°A.

(B) " The high temperature in an atmosphere predominantly nitrogen is continued up to about 160 km., above which some rather doubtful observations indicate the presence of a lighter gas."

During the past winter three spectrographs have been in use under the direction of Professor Vegard at the Geophysical Institute of Tromsö, and the wave lengths of the lines shown by auroræ have been carefully determined. One of the instruments used was a quartz spectrograph with fairly large dispersion, which rendered the study of the auroral spectrum into the ultra-violet possible. The wave lengths of 35 lines were measured and 29 of these lines were determined as belonging to the spectrum of nitrogen as produced in the laboratory, and two others are probably associated with the same spectrum. Four lines remain which are not found among the recorded lines of the nitrogen spectrum. One of the four is the green auroral line which Vegard determines as having wave length 5578.2 Angström units. Since the spectra of hydrogen, helium and oxygen are completely absent he concludes that these four lines must also belong to nitrogen, probably under conditions which have not yet been reproduced in the laboratory. With reference to the possible presence of a small proportion of hydrogen and helium, Vegard's

* The height 37 km. published for the ascent at Pavia, Dec. 7th, 1911, is frequently quoted. The validity of the record is very doubtful however. Ascents above 20 km. are rare. (*Vide Meteorological Magazine*, vol. 55, Nov. 1920, p. 226, and vol. 56, June, 1921, p. 121.)

laboratory experiments have shown that the presence of 7 per cent. hydrogen or 30 per cent. helium can readily be detected in the nitrogen spectrum.

Vegard therefore finds it impossible to accept the view that hydrogen or helium is present in the upper strata of the atmosphere for the following reasons—

(A) The green auroral line is predominant at the bottom edge of the auroræ (*i.e.*, at heights of 95-100 km.) where nitrogen is almost certainly the predominant gas, and the same line is observed to the top of auroral streamers.

(B) If hydrogen or helium were present there would be a change shown in the auroral rays when they pass from heights of about 300 km. to 110 km., but no such changes have been noted.

(C) If hydrogen or helium were present in the upper strata of the atmosphere their presence would be indicated by the auroral spectrum.

He also finds that, assuming nitrogen to be the predominant gas to the very limit of the atmosphere, and assuming the auroræ to be produced by cathode rays, the observed brilliancy of auroræ at heights of 400-600 km. cannot be accounted for unless the density at those heights is greater than that to be expected from calculations based on the theory of molecular diffusion. It is shown that if the greater density which the brightness of the aurora demands were to be accounted for by the higher temperatures indicated by the results of Lindemann and Dobson a temperature of 1078°A. would be essential. Vegard considers that such a temperature must be excluded and supposes that the upper strata are electrically charged and that this charge prevents the nitrogen density in the upper strata from diminishing so rapidly with height as would otherwise be the case. The charged shell enveloping the earth and its atmosphere is explained by assuming that the X and γ rays emitted from the sun detach electrons from the gas molecules, and these electrons on account of their small mass and high velocity fly off from the earth's atmosphere, which in consequence is positively charged. It is shown that under these circumstances the molecules of nitrogen would behave as though they were molecules of a much lighter gas, and that in consequence the nitrogen at great heights would, without assuming excessively high temperatures, be of sufficient density to give rise to the observed phenomena. It is suggested by Vegard that molecules of hydrogen and helium, as a result of their apparent reduction in molecular weight, would also fly off from the earth's

atmosphere. In this connection it is interesting to note that Milne* has recently applied a rigorous mathematical analysis to the question of the escape of molecules and electrons from an atmosphere. He concludes that owing to the escape of electrons there exists a positively-charged shell round the outer atmosphere, but that the rate of loss of hydrogen and heavier constituents is quite inappreciable. Vegard states in a footnote that since writing his paper later investigations have led him to the view that a highly ionized upper layer cannot exist in the form of a gas, but that the charge is attached to clusters of molecules. He also states that his conclusions respecting the increase in density due to the charged state of the gas require revision.

Vegard's results indicate rather definitely that it is nitrogen alone that forms the uppermost atmosphere. Some ten years ago the presence of hydrogen and of helium was taken for granted and the presence of a gas with a still smaller molecular weight (for which the name " geocoronium " was coined) was invoked to explain the green line in the auroral spectrum. Had the comparatively high densities near the limit of the atmosphere, demanded by the brilliancy of the highest auroral streamers, been observed at that time such observations would no doubt have been regarded as a confirmation of the presence of geocoronium. The newer theory which dispenses with the hypothetical geocoronium as well as with hydrogen and helium may be welcomed as tending to simplify our ideas.

In a later paper† (published since the above was written), Vegard states that more recent investigations have led to some modification of his conclusions regarding the physical state of the uppermost strata. He decides that if nitrogen existed in the gaseous state at heights of 500 to 600 km. the density would be so small (because of the escape of molecules into space as a result of their charged condition) that no visible aurora would be produced. To meet the fact that auroral streamers extending to such heights have been observed he assumes that the nitrogen condenses round ions and exists in the form of minute crystals or fine solid dust. Owing to the earth's magnetic field the dust atmosphere would be most extensive near the plane of the magnetic equator and might be expected to form a " dust-ring " round the earth. He then concludes that the blue of the sky, the twinkling of the stars, the Gegenschein and the Zodiacal light are all caused by this dust atmosphere. It is difficult to take this development of the theory seriously.

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* *Cambridge Trans. Phil. Soc.*, vol. xxii., 1923, p. 483.

† *Phil. Mag.* vol. xlvi., Oct., 1923, p. 577.

Discussions at the Meteorological Office

October 15th, 1923. *Meteorological Problems.* 1. *Travelling Cyclones* by V. H. Ryd. (Kjøbenhavn: Publikationer fra det Danske Meteorologiske Institut, Meddelelser, Nr. 5, 1923.) *Opener*—Sir Napier Shaw.

In the paper which was the subject of this discussion, Dr. Ryd puts before his readers, as a picture of the atmospheric structure of middle latitudes, a certain cyclonic distribution of pressure superposed upon a distribution of isobars representing a uniform current of air. The intensity of the current upon which the circular distribution is superposed, increases upwards, from zero at the surface, as a geostrophic wind, the gradient of which is controlled by a distribution of temperature decreasing uniformly upward and northward.

The hypothetical distribution of pressure is computed to give at the "central" region of the cyclonic column (at the level of about 5·5 km.) a distribution in which the velocity of travel is in accordance with the velocity in the auxiliary field at that level.

From these assumptions he calculates the distribution of pressure, the trajectories of air, the paths with regard to the centre and the instantaneous velocities for the ground, the central region and the intermediate level; he also considers the properties of a region above the central.

He explains that the energy of these systems may be derived from the kinetic energy of the drift or auxiliary current, the velocity of which at great heights exceeds that of the travel of the cyclone. He is satisfied that the conclusions are in reasonable agreement with the observed facts.

Sir Napier Shaw expressed the opinion that the paper deserved careful study, and that the conclusions should be further explored. The theory took no account of penetrative convection, and, although the resilience of the atmosphere made the ascent of air from near the surface to great heights an exceptional phenomenon, it did occur sometimes, and its dynamical results ought to be taken into account.

October 29th, 1923. *Les Systèmes Nuageux*, par Ph. Schereschewsky et Ph. Wehrlé (Memorial de l'office National Météorologique de France, No. 1, 1923). *Opener*—Capt. C. K. M. Douglas.

Capt. Douglas has been so good as to prepare the following notes concerning the memoir which was the subject of this discussion.

This memoir has been issued in three separate parts, consisting of text, charts and photographs, and deals with cloud observations as an aid to weather forecasting. It is concerned chiefly

with those cloud systems which are usually associated with precipitation, other types being only briefly referred to. The typical sequence of cloud forms and weather in a moving cyclone was, of course, described by Abercrombie over fifty years ago, and, although since then the use of photography has led to a great advance in our knowledge of cloud structure, most writers have confined themselves to average conditions when dealing with the sequence of events. Recent work in France has aimed at advancing the subject by the detailed study of a large number of individual cases. The weather systems are not very closely related to the isobaric distribution, but rather with the *noyaux de variations* of pressure, or active moving systems, and these are contrasted with centres of action, which are often the main features of the isobaric chart, though the changes are relatively slow. The noyaux are shown up by the use of isallobars, which may form closed systems where the isobaric charts only show an irregularity. It is found that both the noyaux and the cloud systems are carried along in the general current prevailing between 2,000 and 5,000 metres, their respective rates of progress being approximately, but not always exactly, equal.

Since the investigation depends on individual cases, it involves the reproduction of a large number of charts, nearly 400 in all. The area represented includes all central and western Europe up to the North Cape and Iceland on a scale of about 1 inch to 600 miles, so that only large scale phenomena are dealt with. Isobars, isallobars (chiefly for 12-hour periods) and total cloud amounts are shown up by various colours on separate charts, and the charts for a whole series of days appear on the same plate. Amounts of different cloud forms, upper winds and surface temperatures are also published in a few cases.

Two main groups of cloud systems are considered, cyclonic and thundery, and these are divided into various parts, namely, front body, flanks and rear. Full descriptions are given of cloud sequences in the various parts of the systems, both in general and special cases, illustrated by cloud photographs. There are altogether 40 photographs, excellently reproduced, and they are enclosed in coverlets with very full notes on the conditions prevailing. A " cyclonic " system generally sweeps along rapidly on a wide front with a large clearly defined rain area in the middle of the " body," which consists of an extensive mass of alto-stratus type. It may here be mentioned that observations from aeroplanes show that this cloud is several kilometres deep and during rain it usually extends to a fairly low level, often joined to the lower turbulent clouds. The French propose to call this form " nebulum " at lower levels, and " velum " in middle levels.

The " thundery " systems are so-called from their frequent

association with thunder, but they include many different types of weather, among others the worst winter snowfalls in France. The distribution of cloud and precipitation indicates irregularity in the vertical movement, and the characteristic features are shown by the clouds at all heights, including the cirrus. The corresponding noyaux are relatively feeble, irregular, and slow moving. The charts of Part II. illustrate the movements and disintegration of various systems, and the change from a cyclonic to a thundery system, but not the origin of systems, as those over western Europe nearly all come in from the Atlantic.

The authors state their views fully on the observational side of the subject, and on the best methods of conveying the requisite information to a central office. Their scheme appears to demand a higher average standard of cloud observing than has yet been attained, and in particular that skies should be watched constantly and not merely for a minute or so at fixed hours of observation. It is the appearance of the sky as a whole and the changes in progress that are important.

The results so far published are purely empirical in character. It may be hoped that the subject may be placed on a physical basis as soon as possible, and it is therefore desirable that photographic surveys of the sky should synchronise as far as possible with the international investigation of the upper air by means of ballons sondes.

During the discussion it was pointed out that the detailed cloud observations advocated in this paper are being carried out by the French and the results published in their Bulletin Quotidien d'Etudes de l'Office National Météorologique de France. The list of symbols used is reproduced below.

Signes Conventionnels de la Nature du Ciel		Signes Conventionnels des Météores passé et présent	
‖	*Ciel d'intervalle.*	●	*Pluie.*
⊂	*Ciel de marge.*	✱	*Neige.*
⊃⊂	*Ciel de front dépressionnaire.*	⚡	*Orage.*
⊃⊂	*Ciel de front orageux.*	◑	*Averse.*
□	*Ciel de corps dépressionnaire.*	∴	*Grain sans orage.*
▨	*Ciel de corps d'A.-Cu.*	△	*Grêle, grésil.*
▣	*Ciel orageux.*	⊕	*Brouillard.*
⩤	*Traîne faible.*	—●	*Bruine.*
⩤	*Traîne chargée.*	⊖	*Brume.*

The subject for discussion :—

On Nov. 26th, 1923, will be *The Earth and the Sun. An hypothesis of weather and sunspots*, by Ellsworth Huntington (Yale University Press, New Haven, 1923). *Opener*—Dr. C. Chree, F.R.S.

And on Dec. 10th, 1923, *The Preparation and Significance of free Air Pressure Maps for the central and eastern United States* (Monthly Weather Review, Supplement No. 21, Washington, 1922). *Opener*—Mr. E. G. Bilham, B.Sc.

Royal Meteorological Society

A NEW precedent was established by the Royal Meteorological Society by holding the opening meeting of the session in October, instead of in November. The meeting was devoted to the consideration of a memorandum, prepared by Sir Napier Shaw, Capt. D. Brunt, and Miss E. E. Austin: *Towards a basis of meteorological theory; thirty-nine articles of condition for the middle atmosphere.* In this memorandum knowledge of the properties of the middle atmosphere, the layers between 4 and 8 km., is summarised. Naturally the propositions submitted differ largely in importance; some are straightforward deductions from physical laws, but deductions which have frequently been overlooked by theorists, some are the results of observation and await complete explanation, some are statements of opinion on the part of the authors and challenge criticism. In the last category must be reckoned the declaration "the chief effective cause of the general circulation between the equator and the poles and the correlated circulation round the poles is the cooling of the slopes and plateaux of high land in the polar regions." In the course of the discussion Dr. Simpson expressed the opinion that the cause in question could only account for local disturbance of the general circulation.

The most novel suggestion in the memorandum is with regard to what happens at the transition layer between two air currents. It is pointed out that owing to turbulence the change of wind velocity will be gradual; moreover, the turbulence will tend to produce the adiabatic lapse rate, thereby cooling the air at the top of the lower current and possibly producing cloud.

The discussion failed to bring out any new speakers. Have the meteorologists of the younger generation no definite views on the questions at issue?

Correspondence

To the Editor, *The Meteorological Magazine*

Rainfall Insurance

MAY I be allowed to point out on behalf of the Eagle, Star and British Dominions Insurance Co., Ltd., the originators of rainfall insurance, both in this country and America, that the policies issued by this company are never drawn up in the careless manner suggested in the article on Rainfall Insurance in the September issue of the *Meteorological Magazine*. Every policy states clearly whether the insured times are Greenwich Time or Summer

Time, and specifies the place at which the rainfall record must be taken, and the authority for its measurement. In cases where no official observer is available, a rain gauge is installed at or near the site of the risk, and arrangements made with some disinterested person to take the reading. As an indication of the care which is taken over these details, it may be stated that during the last three years over 40,000 rainfall records have been obtained in connection with policies issued, and the number of occasions on which there has been any failure in the arrangements made has been not more than twenty-five.

Unfortunately, although the Company is probably writing over 95 per cent. of the rainfall policies issued in this country, there are policies which emanate from other sources and which, owing to lack of experience and facilities on the part of the insurers, may be justly characterised as " very carelessly drawn up."

With regard to rain insurance generally, the writer of the article has pointed out the weak spot of such insurances when based on a stipulated measurement of rain. The ideal policy would be based on a combination of the intensity, duration and amount of the rain ; but such a policy, as stated, would necessitate for each risk the provision of a reliable recording rain gauge, which, in view of the average amount of premium per policy, is at present impracticable. Wherever such rain gauges are available, however, " Pluvius " policies can be issued based on the duration of the rain as apart from the measurement. Further, the issue of policies, guaranteeing payment of definite sums in the event of a stipulated measurement of rain, is discouraged as much as possible. It is preferable to cover against a small measurement of rain for a short period during which rain would be most likely to affect the success of the event, and to guarantee that the receipts will not fall below a specified sum. In the example quoted in the article we would have suggested that the rainfall measurement be 0·05 of an inch during a period of 3 hours (say 2 hours prior to the start and 1 hour after), the policy paying the difference between the actual receipts and the sum insured, in which case the assured would have received the amount of loss incurred. In other cases, however, such as cricket matches, a rainfall stipulation, whether of duration or amount, is not satisfactory, as it frequently happens, owing to heavy rain on the previous night, or early morning, that no play is possible on the insured day. In " Pluvius " policies this difficulty is overcome by the provision that the policy will come into force in the event of play being stopped for a specified period as a consequence of rainfall, no measurement or period of rain being stipulated.

With regard to investigations in America, these have been

initiated by the Eagle, Star and British Dominions Insurance Company, Ltd., who now form part of what is known as the "Rainfall Association," comprised of all the companies in the United States who are writing rain insurance, and the question of issuing policies on the lines suggested, *i.e.*, against a fall of one-hundreth of an inch in any one or more hours depends entirely on the accumulation of statistics necessary to adequately rate such policies. For this purpose a series of hourly readings for long periods and for a large number of localities is required.

The writer, being in charge of the arrangements for obtaining rainfall records, and for collecting rain statistics, would like to take this opportunity of thanking the officials of the Meteorological Office, the British Rainfall Organization, and the many observers all over the country for their uniform courtesy and help in this work.

In conclusion, it should be noted that the advent of rain insurance on a large scale has created a great interest in the question of rainfall, and has led a number of people, hitherto uninterested, to study the matter, and in many cases to instal rain gauges, all of which must be of ultimate benefit to the science of meteorology.

INIGO R. WILLIAMS, F.R.Met.Soc.

Eagle, Star and British Dominions Insurance Co., Ltd., E.C. 2.

A curious Lunar Rainbow

AT 7h. 30m., on September 22nd, passengers about to embark on a steamer at Bowness, on Lake Windermere, observed a lunar rainbow, the red and violet tints of which were faintly visible. Later, as we steamed southwards towards Lakeside, standing alone on deck, I saw another duller bow appear outside the first bow. The two bows now spanned from earth to earth. Then to my surprise the inner and brighter bow broadened centripetally, losing its colours and extending downwards until it became a white half-disc, like a gigantic half-moon, still fringed by the outer bow. Lastly, I watched both outer bow and luminous half-disc fade away. At no time did I see any colour in the outer bow as it was too faint.

J. C. WALLER.

The Hartley Botanical Laboratories, University of Liverpool, Sept. 27th, 1923.

[The interpretation of Mr. Waller's interesting observation is difficult owing to our unfamiliarity with the physiological side of the question of the visibility of faint luminosity. Many people have never noticed the contrast in tone between the inside of the primary rainbow and the space between the primary

and secondary bows, as seen in the day time, but it is conspicuous when once it has been discovered and it shows up well in photographs such as the one* in Clarke's "Clouds." Observers' reports suggest that such a contrast is more striking in the case of lunar rainbows, perhaps because the colours are not readily perceived. Growing appreciation of the contrast would explain Mr. Waller's observation.—ED. *M.M.*]

Weather Parallels

ON November 2nd, 1903, I addressed to this Magazine, from North Cadbury Rectory, in east Somerset, a short letter which appeared in the November number. It ran as follows:—

> "I wish to call attention to the parallel between 1891 and 1903. It is really very close for a great part of the year, and especially for October. The question suggests itself, will there now be a ten days anticyclone as there was then?"

To this letter was appended the following note by the Editor:—

> "The question propounded above has been answered by the barometer, for the anticyclonic condition which was fully established on November 4th lasted with one slight break until the 13th, when we send this sheet to press.—Ed. *S.M.M.*"

That number was full of letters about the excessive rainfall and storminess of the previous October. It had also plentiful reference to the wet Octobers of 1891 and 1865.

Again the question may be asked is the anticyclone in early November being repeated? In 1891 there was an anticyclone, with quiet and almost rainless weather from October 27th to November 8th. And now, on October 30th, the barometer rose from its long spell of depression to considerably above normal, and here it has been nearly dead calm, without any measurable rain for three days.

I may add that the rainfall here of the October just finished was 164 mm.

Returns from east Somerset, west Wilts. and north Dorset show a range from 170 mm. to 114 mm., but these figures are somewhat below those of October, 1903, when at North Cadbury, a comparatively dry station, I measured 163 mm.

H. A. BOYS, F.R.Met.Soc.

Spring Hill, S. Mary Bourne, Andover, November 2nd, 1923.

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* Reproduced in the Dictionary of Applied Physics, Vol. iii., p 523.

NOTES AND QUERIES

A remarkable Wind Record—Southport, August 29th-30th, 1923

AUTOGRAPHIC records obtained during the passage of a deep cyclonic depression are always of particular value. The depression which crossed the British Isles on August 29th was, for a summer storm, unusual in its depth and intensity, and records obtained at stations near the path of the centre are therefore of more than ordinary interest. It is not proposed here to consider the disturbance in detail, except in so far as light can be thrown upon the very remarkable records obtained at the Fernley Observatory, Southport, on that occasion.

From the anemograms reproduced in Fig. 1, we may briefly summarise the wind sequence as follows :—

A	29th 9h. to 15h.	Wind SE by S, force 3 to 4, gradually backing to ESE and freshening to force 6.
B	29th 15h. to 20h.	Wind ESE veering to SE and dying away gradually to calm.
C	29th 20h. to 20h. 55m. ...	Dead calm.
D	29th 20h. 55m.	Sudden onset of NW wind increasing within about 10 minu es to force 9.
E	29th 21h. 10m. to 30th 9h....	Wind NW, force 9, backing slowly to W and decreasing to force 8.

From the records of temperature and pressure we learn (1) that the easterly wind of stages A and B was slightly warmer than the northwesterly current of stage E ; (2) that the barometer ceased falling and began to rise slowly at 18h. ; that is to say three hours earlier than the arrival of the north-west current. The latter event, however, synchronised with a marked increase in the rate of rise.

The synoptic chart for 18h., August 29th, is reproduced in Fig. 2, which also shows the track of the centre as accurately as it could be ascertained from the working charts. It will be seen that there was at that hour a rather abrupt discontinuity of wind direction between Liverpool and Holyhead. The winds at those two stations were in fact representative of the B and E stages in the Southport record. It is not easy, however, to see how it was that Southport enjoyed a dead calm for so long as an hour before the northwesterly gale replaced the easterly current. The anemogram suggests that the centre of the cyclone was passing the station between 20h. and 21h., but the synoptic charts hardly admit of this possibility. If the centre actually moved northward towards Southport after 18h., before resuming its north-eastward movement, there would inevitably have been

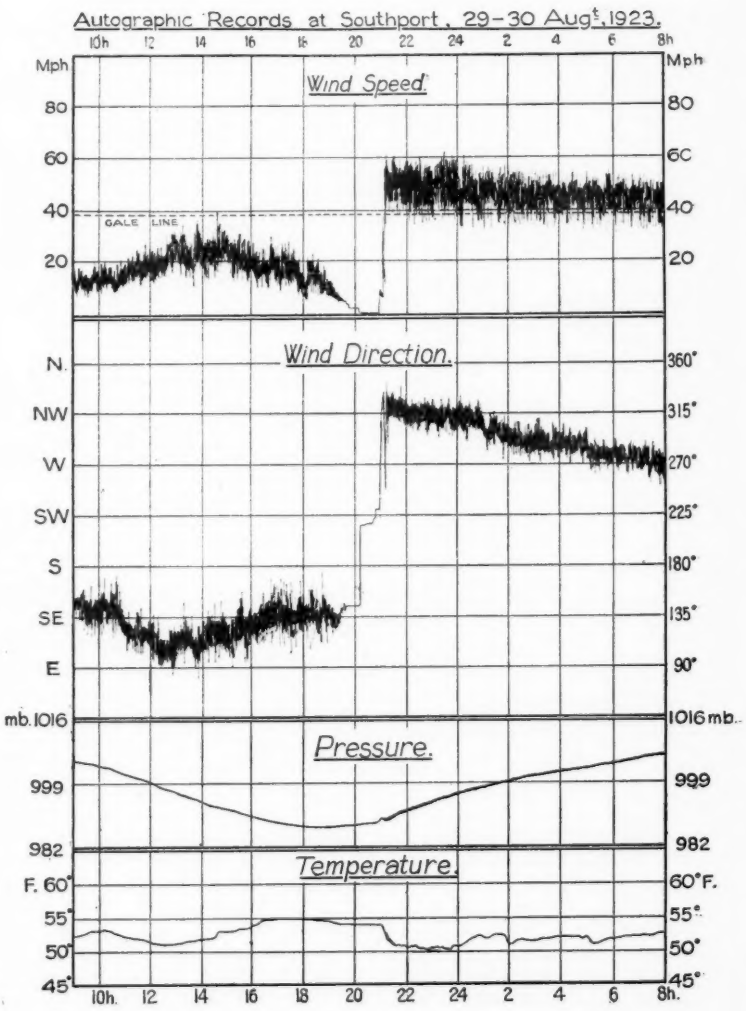
Autographic Records at Southport, 29–30 Aug.t, 1923.
10h 12 14 16 18 20 22 24 2 4 6 8h
Mph
80
60
40
20
Wind Speed.
GALE LINE
N.
NW
W
SW
S
SE
E
360°
315°
270°
225°
180°
135°
90°
Wind Direction.
mb. 1016
999
982
Pressure.
1016 mb.
F. 60°
55°
50°
45°
Temperature.
10h. 12 14 16 18 20 22 24 2 4 6 8h.

FIG 1.

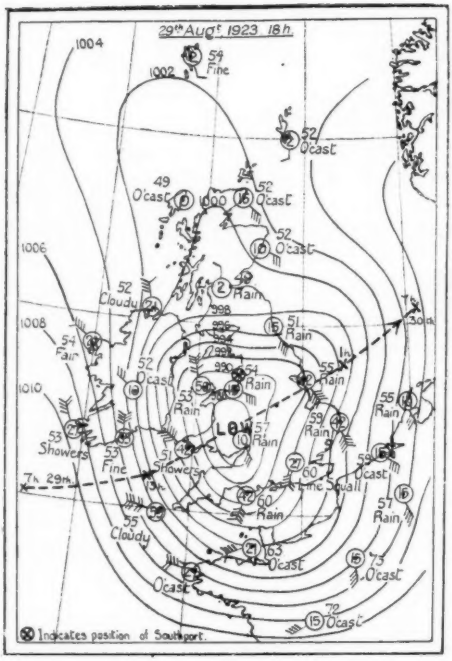

FIG 2

a slight fall of the barometer there, whereas a rise was recorded. The alternative explanation, that there was a subsidiary centre north of that shown on the chart, seems feasible in view of the fact that the isobars indicate quite a number of small irregularities or "secondaries" round the main centre. The 18h. chart, however, shows no trace of a secondary over Lancashire, and we have therefore to consider how the distribution may have changed between 18h. and 20h. in order to produce the required result.

In this endeavour our attention is at once drawn to a marked bulge in the isobars towards Spurn Head, indicating a small secondary centred somewhere near Sheffield. Applying the principle that secondaries travel round the main centre with the speed of the average gradient wind, this secondary would have moved, had the main cyclone remained stationary, to a position near Anglesey by 20h. The main centre was, however, moving towards east-north-east at about 35 miles per hour, and this would bring the secondary just about over Lancashire at 20h. There is nothing in the autographic records* which fails to fit in with this theory, and it is indeed a common habit of small secondaries to produce calms or light winds temporarily in places where there would have been a gale in their absence. It is not often, however, that circumstances adjust themselves so as to produce so remarkable a result as that under consideration.

E. G. BILHAM.

* This refers only to records received in the Meteorological Office. Perhaps readers in the north of England who have autographic records will examine them and test this theory.

Light Aeroplane Contests

THE series of contests for light aeroplanes organised by the Royal Aero Club, and held at Lympne Aerodrome between October 8th and 13th, proved of great interest. Its success was unbroken until the last day, which was a sad one, for it was marred by the tragic death of M. A. Maneyrol, the French pilot, who last year won the prize at the Itford Gliding Competition. In the morning he had reached a height of 9,400 ft., but went up again in the afternoon in an attempt to make an unbeatable record. It is thought that M. Maneyrol unwittingly put his machine down at too steep an angle when he was about 150 ft. from the ground. However that may be, the wings doubled back and the aeroplane crashed to the ground. The sealed barograph was found, but, unfortunately, was too badly damaged for the record to be read.

The main object of the contests was the development of a low-powered and easily transportable aeroplane. No machine was allowed an engine of over 750 c.c. capacity.

The contests were held over a triangular course, 12½ miles in length, running approximately 3 miles north-east to Postling, 4½ miles north-west parallel to the North Downs to West Brabourne, and, finally, 5 miles south-south-east back to the aerodrome. The aerodrome itself stands at a height of 350 ft. above sea level, on the top of a ridge running east-west. This ridge on its southern side falls somewhat steeply to Romney Marsh, while on the northern side a valley separates the aerodrome from the North Downs, which, at the nearest point, are slightly more than 3 miles away. The land in the district is mainly pasture, and the large fields provide ample facilities for any forced landings which may be made outside the aerodrome. The general contour of the country is such that considerable assistance may be obtained by upward currents with south or south-west winds, but practically throughout the week west or north-west winds prevailed, and thus were blowing almost parallel to the ridge and the North Downs.

Four contests were carried through during the week.

1. The greatest distance covered by the use of one gallon of fuel.
2. The greatest average speed over two laps of the course.
3. The largest number of circuits of the course during the week.
4. The maximum altitude attained.

It was hoped at the end of the week to arrange for a landing and taking-off contest, but weather conditions prevented this being done.

For the first of these contests the best results would be expected in a calm or with light south or south-west winds, where height might be gained in ascending air currents on the south side of the aerodrome or near the Downs, and the engine throttled down when descending to a lower level. For the speed contest a calm

was wanted in order to obtain the best figures. Meteorological conditions entered less into the third and fourth contests, and, here, reliability of the machine and endurance on the part of the pilot were of most importance.

Throughout almost the whole period of the contest the district was under the influence of a westerly type of weather, and secondary depressions, with the accompanying strong winds, low clouds, bad visibility, and precipitation, combined to reduce very much the time during which flying was in progress. Only on a few occasions and for short intervals was it possible to make attempts to beat the economy and speed figures, but the reliability of the machines was shown by the consistency with which the pilots added to their total mileage round the course.

Although the weather for much the greater part of the week was most unfavourable for flying, these light aeroplanes made some really wonderful performances. On occasion the conditions caused by low cloud, bad visibility, and rain were such that the high-powered aeroplanes used on the regular cross-Channel services would have been compelled to land and discontinue their flights. Yet even under these circumstances some of the light aeroplanes continued to "lap the course." During the short favourable intervals some splendid performances were recorded, and it is fairly safe to assume that under more favourable conditions the best types would approach 100 miles per gallon, and that a speed of 80 m.p.h. would be exceeded. The safety of most of the types entered was frequently exhibited, for, while a considerable number of forced landings were made, in all but the one tragic case both pilot and machine escaped without so much as a scratch. Further, such engine repairs as were necessary were often done on the spot and the machine then continued its flight around the course. Where this was not possible, the aeroplane could be easily dismantled and wheeled back to the aerodrome along the neighbouring roads. In fact, all machines had to pass a test in which they were dismantled and wheeled along a road for one mile by two persons without the help of any extraneous tackle.

The prize for the greatest height went to Mr. Piercey, who reached 14,400 ft. The greatest distance covered using only one gallon of fuel was 87·5 miles, by Ft.-Lt. W. H. Longton and Mr. James; and the greatest average speed over two laps of the course was 76·1 m.p.h., by Capt. Macmillan, who also in a further test reached 82 m.p.h. before engine trouble caused him to descend halfway round the second lap. Mr. Hinkler succeeded in flying 80 times round the course, or 1,000 miles during the week.

Although the bad weather experienced rendered the flying distinctly less pleasant, it had the advantage of showing that

these light aeroplanes are far from being suitable for flying only in fine weather. Machines which are capable of lapping a course such as this in winds reaching gale force, with low clouds descending at times so as to envelop the aerodrome and reducing the visibility to quite low values, and in continuous rain, must have a great future. R.S.R.

Horse Racing and Weather Insurance

INSURANCE played a large part in the financial arrangements in connection with the much boomed race between Papyrus, the English Derby winner, and Zev, the champion American horse, which took place at Belmont Park, Long Island, on October 20th.

A rain insurance policy was issued to the Westchester Racing Association, the organisers of the race, for $50,000 to be paid in the event of the rainfall between 9 a.m. and 1 p.m. amounting to 0·1 in. Although a considerable amount of rain fell on the previous day, the weather was fine on the day of the race and the underwriters were not called upon to pay.

It is understood that in addition to the rain insurance a policy was issued for $100,000 payable if the race was not run for any reason except rain, and life policies were issued for $250,000 on the life of Papyrus and $50,000 on that of Zev.

News in Brief

We are gratified to learn that the King has approved of the award by the President and Council of the Royal Society of a Royal Medal to Sir Napier Shaw, F.R.S., for his researches in meteorological science. The Copley Medal of the Royal Society has been awarded to Prof. H. Lamb for researches in mathematical physics.

The " Jevons Memorial " Lectures for 1923-4 are being given by Mr. R. H. Hooker at University College, London, on Fridays, November 9th, 16th, 23rd and 30th, at 5.30 p.m. The subject is " The Weather and the Crops." The lectures are open to the public without fee or ticket.

The Times states that at Issy-les-Moulineaux on October 29th M. Sadi Lecointe, the French airman, made an attempt to beat the world's altitude " record " of 34,000 ft., of which he was the holder. A height of 35,273 ft. is said to have been indicated, but the allowances for temperature, &c., will have to be made before the exact height can be stated.

The Government of the Falkland Islands is publishing for its own use a summary of Geophysical Memoirs No. 15, *The Climate*

and Weather of the Falkland Islands and South Georgia, by C. E. P. Brooks, M.Sc. In this summary British Units are used.

Obituary

Dr. Arthur A. Rambaut, F.R.S., who had been Radcliffe Observer at Oxford since 1897, died on Oct. 14th. His chief work was in connection with stellar parallax and a volume of the Radcliffe observations containing the parallaxes of 2,400 stars was published about a month before his death. Though astronomy was his favourite subject he devoted some time to meteorology, his chief contribution to this science being his studies on earth thermometry.

We also learn with regret of the death on Oct. 3rd of Dr. H. McLeod, F.R.S. Dr. McLeod took a keen interest in meteorology making daily observations at 9 a.m. and 3 p.m. over a period of twenty years at the Royal Indian Engineering College, Cooper's Hill, Egham, where he was professor of experimental science. Summaries of the observations were published in the Monthly Weather Report, etc. He also devised a sunshine recorder. His name is more familiar, however, as the inventor of the McLeod gauge for the measurement of low pressures.

The Weather of October, 1923

THE main features of the pressure distribution of the month were the persistence of the deep depressions off the north-west coasts of the British Isles and the frequent passage of secondaries further south. Unsettled weather with south-westerly winds and a moderate temperature therefore prevailed throughout the greater part of the month though there were also considerable bright periods with the result that some districts experienced an excess of sunshine as well as of rain. The rainfall of the month was greatly in excess of the normal of the period 1881 to 1915. Areas with more than 50 per cent. in excess were widespread, occurring mainly to the west of Great Britain and in the south-east of England. As much as twice the normal occurred in western Argyllshire and in the English Lake District and practically this amount fell to the south of London. The largest value for the month was 35 ins. (889 mm.) at the Stye at the head of Borrowdale in Cumberland. At Kew Observatory rain fell on each day of the month with the exception of the 4th. Over a coastal strip from southern Aberdeenshire to the Wash the total for the month was below the normal, the deficiency being rather more than 50 per cent. in the neighbourhood of Spurn Head. For the British Isles generally the previous five Octobers have been below the normal but in the last twenty

years there have been six Octobers with a bigger rainfall than that of the present year. Gales occurred on the 3rd and again from the 9th to the 13th; force 10 (average 59 mph.) being recorded in the Shetland Isles and east Scotland on the 9th. High winds or gales were also experienced on some or other exposed part of the coast from the 18th to 30th. The lowest temperatures of the month occurred in the first and third weeks, the 5th, 14th and 15th being the coldest nights over the country generally. 25° F. was registered by the screen minimum thermometer at Eskdalemuir on the 14th, and 26° F. at Balmoral on the 5th, while grass minima fell to 19° F. at Wisley and Rhayader on the 5th, and to 20° F. at Wisley on the 15th. The 9th and 19th stand out as the two warmest days generally. Thunderstorms occurred in many parts of the country during the latter part of the month and at a number of stations hail was reported.

October was characterised by remarkably wet and stormy weather in many parts of the globe. On the night of the 4th a violent storm swept the English Channel and northern France. The Channel boats were unable to cross and a number of wrecks were reported. Later in the month storms in the Atlantic delayed the liners. About the 2nd a hurricane swept over Newfoundland and the Maritime Provinces, doing great damage to the apple crop. Heavy rain in the valley of the Canadian river caused a flood which inundated Oklahoma on the 16th, and on the 18th a number of passengers in the "Aquitania" were injured in a violent easterly gale off Nantucket. On the 23rd it was reported that owing to heavy rain in the Chagres region during the preceding three days the level of Lake Gatun had risen to such an extent that traffic through the Panama Canal was interrupted for a few days. On the 15th it was reported that good rains were being experienced throughout Victoria (Australia).

The special message from Brazil states that the rainfall was 13 mm. below the normal in the north, plentiful in the central regions where the average was 42 mm. above the normal, and irregular in the south. Temperature was slightly above normal. The cotton crop has been much reduced by boll-weevil but the prospects of the wheat harvest are very good. The coffee picking is almost over. At Rio de Janeiro itself the mean pressure for the month was 2 mbs. above normal and the mean temperature 2° F. above normal.

Rainfall October, 1923: General Distribution

England and Wales	133	per cent. of the average 1881-1915.
Scotland	142	
Ireland	125	
British Isles	134	

Rainfall Table for October, 1923

CO.	STATION.	In.	mm.	Per-cent. of Av	CO.	STATION.	In.	mm.	Per-cent. of Av.
Lond.	Camden Square.....	5·94	151	226	*Leics*	Leicester Town Hall...	2·69	68	...
Sur .	Reigate, Hartswood...	8·37	213	...	,, .	Belvoir Castle.....	2·55	65	94
Kent.	Tenterden, View Tower	6·06	154	174	*Rut* .	Ridlington.....	3·36	85	...
,, .	Folkestone, Boro. San.	6·27	159	...	*Linc.*	Boston, Skirbeck	2·43	62	89
,, .	Broadstairs	...	...	...	,, .	Lincoln, Sessions House	1·49	38	58
,, .	Sevenoaks, Speldhurst.	6·80	173	...	,, .	Skegness, Estate Office.	1·49	38	54
Sus .	Patching Farm.....	6·92	176	175	,, .	Louth, Westgate	1·73	44	53
,, .	Eastbourne, Wilm. Sq.	7·10	180	171	,, .	Brigg	1·53	39	51
,, .	Tottingworth Park....	7·26	184	175	*Notts.*	Worksop, Hodsock....	1·44	37	55
Hants	Totland Bay, Aston...	5·74	146	140	*Derby*	Mickleover, Clyde Ho..	2·52	64	94
,, .	Fordingbridge, Oaklnds	5·68	144	137	,, .	Buxton, Devon. Hos...	5·65	144	115
,, .	Portsmouth, Vic. Park.	5·79	147	157	*Ches.*	Runcorn, Weston Pt...	4·34	110	126
,, .	Ovington Rectory	6·65	169	164	,, ..	Nantwich, Dorfold Hall	4·23	107	...
,, .	Grayshott	6·84	174	164	*Lancs*	Bolton, Queen's Park .	5·87	149	...
Berks	Wellington College...	...	...	...	,, ..	Stonyhurst College....	6·56	167	146
,, .	Newbury, Greenham..	5·59	142	160	,, ..	Southport, Hesketh...	4·52	115	128
Herts.	Bennington House....	4·24	108	156	,, ..	Lancaster, Strathspey.	7·33	186	...
Bucks	High Wycombe	5·47	139	175	*Yorks*	Sedbergh, Akay	10·88	276	218
Oxf..	Oxford, Mag. College..	3·87	98	139	,, .	Wath-upon-Dearne ...	1·62	41	58
Nor .	Pitsford, Sedgebrook..	3·93	100	147	,, .	Bradford, Lister Pk...	3·07	78	88
,, .	Eye, Northolm.....	2·67	68	...	,, .	Oughtershaw Hall	12·65	321	...
Beds.	Woburn, Crawley Mill.	3·58	91	132	,, .	Wetherby, Ribston H..	2·77	70	92
Cam.	Cambridge, Bot. Gdns.	3·84	98	163	*ERY*	Hull, Pearson Park ...	1·37	35	46
Essex	Chelmsford, CountyLab	4·68	120	...	,, .	Holme-on-Spalding ...	1·45	37	...
,, .	Lexden, Hill House...	3·87	98	...	,, .	Lowthorpe, The Elms.	1·64	42	50
Suff .	Hawkedon Rectory ...	4·26	108	158	*NRY*	West Witton, Ivy Ho..	5·06	129	...
,, .	Haughley House.....	3·36	85	...	,, .	Pickering, Hungate ...	2·37	60	...
Norf.	Beccles, Geldeston....	2·83	72	100	,, .	Middlesbrough	1·99	51	66
,, .	Norwich, Eaton	3·62	92	116	,, .	Baldersdale, Hury Res.	5·25	133	133
,, .	Blakeney	3·12	79	119	*Durh.*	Ushaw College	1·92	49	56
,, .	Swaffham	3·18	81	110	*Nor* .	Newcastle, Town Moor.	2·21	56	69
Wilts.	Devizes, Highclere....	5·46	139	...	,, .	Bellingham Manor....	3·34	85	...
Dor .	Evershot, Melbury Ho.	5·71	170	145	,, .	Lilburn Tower Gdns..	2·39	61	...
,, .	Weymouth, Westham..	5·05	128	138	*Cumb*	Penrith, Newton Rigg..	...	...	...
,, .	Shaftesbury, Abbey Ho.	5·87	149	151	,, .	Carlisle, Scaleby Hall .	5·46	139	163
Devon	Plymouth, The Hoe...	5·19	132	132	,, .	Seathwaite	23·00	584	192
,, .	Polapit Tamar	7·91	201	165	*Glam.*	Cardiff, Ely P. Stn.....	6·81	173	142
,, .	Ashburton, Druid Ho..	10·54	268	174	,, .	Treherbert, Tynywaun	15·58	396	...
,, .	Cullompton	5·64	143	137	*Carm*	Carmarthen Friary....	7·67	195	134
,, .	Sidmouth, Sidmount ..	4·72	120	127	,, .	Llanwrda, Dolaucothy.	11·02	280	174
,, .	Filleigh, Castle Hill ...	8·12	206	...	*Pemb*	Haverfordwest, Portf'd	...	...	...
,, .	Hartland Abbey.....	5·37	136	...	*Card.*	Gogerddan.....	9·23	234	175
Corn.	Redruth, Trewirgie	6·56	167	125	,, .	Cardigan,County Sch. .	8·21	209	...
,, .	Penzance, Morrab Gdn.	5·63	143	121	*Brec.*	Crickhowell, Talymaes	9·25	235	...
,, .	St. Austell, Trevarna..	6·94	176	132	*Rad* .	Birm.W.W.Tyrmynydd	9·43	239	143
Som	Street, Hind Hayes ...	5·14	131	...	*Mont.*	Lake Vyrnwy	11·78	299	207
Glos..	Clifton College	5·32	135	141	*Denb.*	Llangynhafal	5·54	141	...
,, .	Cirencester	5·10	129	150	*Mer* .	Dolgelly, Bryntirion..	12·00	305	197
Here.	Ross, County Obsy. ...	5·49	139	167	*Carn.*	Llandudno	4·40	112	123
,, .	Ledbury, Underdown.	5·17	131	168	,, .	Snowdon, L. Llydaw 9	23·97	609	...
Salop	Church Stretton.....	6·14	156	170	*Ang* .	Holyhead, Salt Island.	4·61	117	116
,, .	Shifnal, Hatton Grange	3·18	81	112	,, .	Lligwy	6·52	166	...
Staff.	Tean, The Heath Ho...	3·22	82	100	*Man.*	Douglas, Boro' Cem...	6·76	172	146
Worc.	Ombersley, Holt Lock.	3·65	93	137	*Guer.*	St. Peter Port, Grange.	7·70	195	171
,, .	Blockley, Upton Wold.	6·48	165	198	*Wigt.*	Stoneykirk, Ardwell Ho	4·02	102	111
War	Farnborough.....	5·91	150	187	,, .	Pt. William, Monreith .	5·00	127	...
,, .	Birminghm, Edgbaston	3·50	89	126	*Kirk.*	Carsphairn, Shiel.	11·63	295	...

Rainfall Table for October, 1923—*continued*

CO.	STATION.	In.	mm.	Per-cent. of Av	CO.	STATION.	In.	mm	Per-cent. of Av.
Kirk.	Dumfries, Cargen	7·38	187	169	*Caith*	Loch More, Achfary	12·36	314	159
Dum	Drumlanrig	6·20	157	144	,, ..	Wick	4·42	112	149
Roxb	Branxholme	4·18	106	129	*Ork .*	Pomona, Deerness	6·42	163	169
Selk .	Ettrick Manse	8·54	217	...	*Shet .*	Lerwick	4·73	120	120
Berk.	Marchmont House	3·54	90	93	*Cork.*	Caheragh Rectory	7·38	187	...
Hadd	North Berwick Res.	1·32	33	45	,, ..	Dunmanway Rectory	7·55	192	126
Midl	Edinburgh, Roy. Obs.	1·79	46	69	,, ..	Ballinacurra	3·95	100	97
Lan .	Biggar	3·97	101	132	,, ..	Glanmire, Lota Lo.	5·74	146	138
Ayr .	Kilmarnock, Agric. C.	6·00	152	171	*Kerry*	Valencia Obsy.	6·92	176	124
,, .	Girvan, Pinmore	7·71	196	154	,, .	Gearahameen	11·50	292	...
Renf.	Glasgow, Queen's Pk.	4·67	119	144	,, .	Killarney Asylum	6·60	168	123
,, .	Greenock, Prospect H.	9·37	238	174	,, .	Darrynane Abbey	4·25	108	84
Bute .	Rothesay, Ardencraig	7·59	193	172	*Wat .*	Waterford, Brook Lo.	3·92	100	100
,, .	Dougarie Lodge	6·27	159	...	*Tip .*	Nenagh, Cas. Lough	4·63	118	137
Arg .	Glen Etive	14·26	362	...	,, .	Tipperary	4·40	112	...
,, .	Oban	10·20	259	...	,, .	Cashel, Ballinamona	4·33	110	120
,, .	Poltalloch	10·12	257	203	*Lim .*	Foynes, Coolnanes	4·55	116	123
,, .	Inveraray Castle	14·69	373	209	,, .	Castleconnell Rec.	5·97	152	...
,, .	Islay, Eallabus	11·25	286	236	*Clare*	Inagh, Mount Callan	7·91	201	...
,, .	Mull, Benmore	24·60	625	...	,, .	Broadford, Hurdlest'n.	5·89	150	...
,, .	Mull, Quinish				*Wexf*	Newtownbarry	4·15	105	...
Kinr.	Loch Leven Sluice	3·17	81	92	,, .	Gorey, Courtown Ho.	4·37	111	123
Perth	Loch Dhu	12·10	307	169	*Kilk.*	Kilkenny Castle	3·58	91	114
,, ..	Balquhidder, Stronvar.	11·89	302	174	*Wic .*	Rathnew, Clonmannon	3·16	80	...
,, ..	Crieff, Strathearn Hyd.	4·68	119	119	*Cars.*	Hacketstown Rectory	4·44	113	117
,, ..	Blair Castle Gardens	5·25	133	...	*QCo..*	Blandsfort House	4·14	105	118
,, .	Coupar Angus School	2·89	73	101	,,	Mountmellick	4·87	124	...
Forf.	Dundee, E. Necropolis	2·23	57	84	*KCo.*	Birr Castle	4·49	114	154
,, .	Pearsie House	3·86	98	...	,, .	Ballycumber, Bellair	4·61	117	...
,, .	Montrose, Sunnyside	2·50	63	91	*Dubl.*	Dublin, FitzWm. Sq.	2·05	52	76
Aber.	Braemar Bank	4·06	103	108	,, .	Balbriggan, Ardgillan	2·43	62	90
,, .	Logie Coldstone Sch.	3·21	81	99	*Me'th*	Drogheda, Mornington	2·04	52	...
,, .	Aberdeen, Cranford Ho	3·60	91	111	*W.M*	Mullingar, Belvedere	4·24	108	136
,, .	Fyvie Castle	3·31	84	...	*Long*	Castle Forbes Gdns.	4·70	119	...
Mor .	Gordon Castle	3·38	86	107	*Gal .*	Galway, Waterdale	...	...	...
,,	Grantown-on-Spey				*Mayo*	Crossmolina, Enniscoe	7·57	192	146
Na .	Nairn, Delnies	3·35	85	143	,, .	Mallaranny	10·83	275	...
Inv..	Ben Alder Lodge	11·41	290	...	,, .	Westport House	6·47	164	144
,, .	Kingussie, The Birches	4·08	104	...	,, .	Delphi Lodge	14·32	364	...
,, .	Fort Augustus	7·31	186	185	*Sligo*	Markree Obsy.	5·79	147	143
,, .	Loch Quoich, Loan	25·10	637	...	*Ferm*	Enniskillen, Portora	4·33	110	...
,, .	Glenquoich	18·82	478	188	*Arm.*	Armagh Obsy.	3·46	88	127
,, .	Inverness, Culduthel R.	3·10	79	...	*Down*	Warrenpoint	3·17	81	...
,, .	Arisaig, Faire-na-Squir	10·39	264	...	,, .	Seaforde	4·28	109	120
,, .	Fort William	14·08	358	200	,, .	Donaghadee	3·06	78	106
,, .	Skye, Dunvegan	10·66	271	...	,, .	Banbridge, Milltown	2·95	75	107
,, .	Barra, Castlebay	4·33	110	...	*Antr.*	Belfast, Cavehill Rd.	4·72	120	...
R&C	Alness, Ardross Cas.	5·15	131	134	,, .	Glenarm Castle	5·47	139	...
,, .	Ullapool	7·55	192	...	,, .	Ballymena, Harryville	5·31	135	144
,, .	Torridon, Bendamph	13·13	333	164	*Lon .*	Londonderry, Creggan	5·07	129	138
,, .	L. Carron, Plockton	9·61	244	...	*Tyr .*	Donaghmore	4·16	106	...
,, .	Stornoway	7·45	189	144	,, .	Omagh, Edenfel	5·03	128	137
Suth.	Dunrobin Castle				*Don .*	Malin Head	4·51	115	153
,, .	Lairg	5·43	138	...	,, .	Letterkenny Hospital	6·59	167	157
,, .	Forsinard				,, .	Dunfanaghy	6·23	158	142
,, .	Tongue Manse	6·45	164	154	,, .	Narin,-Kiltoorish	6·44	164	...
,, .	Melvich School	5·57	141	152	,, .	Killybegs, Rockmount	8·45	215	151

Climatological Table for the British Empire, May, 1923

STATIONS	PRESSURE		TEMPERATURE							Relative Humidity	Mean Cloud Am'nt	PRECIPITATION			BRIGHT SUNSHINE	
			Absolute		Mean Values				Mean							
	Mean of Day M.S.L.	Diff. from Normal	Max.	Min.	Max.	Min.	½ max. and min.	Diff. from Normal	Wet Bulb.			Am'nt	Diff. from Normal	Days	Hours per day	Per-centage of possi-ble.
	mb.	mb.	° F.	° F.	° F.	° F.	° F.	° F.	° F.	%	0—10	mm.	mm.			
London, Kew Obsy.	1013·7	— 2·2	78	35	59·3	44·0	51·7	— 1·7	47·4	74	7·2	52	+ 8	16	5·3	34
Gibraltar	1017·0	+ 2·1	79	54	71·3	57·9	64·6	— 0·7	59·0	74	4·3	4	— 41	5	...	...
Malta	1015·4	+ 1·7	79	57	71·8	61·7	66·7	+ 1·6	61·7	75	4·3	1	— 9	2	9·6	66
Sierra Leone	1011·0	— 0·7	91	70	88·3	74·7	81·5	— 0·5	76·7	73	6·9	207	— 76	18	...	...
Lagos, Nigeria	1010·2	— 0·8	90	72	87·4	74·9	81·1	— 0·1	77·2	76	7·7	344	+ 81	20	...	...
Kaduna, Nigeria	1012·6	— 0·5	93	60	89·5	68·6	79·1	0·0	71·4	68	1·1	163	— 23	14	...	...
Zomba, Nyasaland	1014·2	— 0·1	82	46	74·0	56·3	65·1	— 0·6	...	83	5·1	54	+ 29	10	...	...
Salisbury, Rhodesia	1015·4	— 2·7	87	39	75·3	46·1	60·7	+ 0·2	55·1	69	2·3	10	— 2	2	...	...
Cape Town	1016·8	— 1·1	81	40	65·5	50·4	57·9	— 0·7	54·7	78	5·6	136	+ 35	13	...	...
Johannesburg	1018·9	— 0·8	72	32	64·7	45·4	55·1	+ 0·7	45·2	62	2·8	4	— 14	3	8·7	81
Mauritius	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Bloemfontein	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Calcutta, Alipore Obsy.	1002·6	— 0·9	106	72	97·1	79·0	88·1	+ 2·1	78·7	72	7·0	26	—120	2*	...	...
Bombay	1007·1	— 0·6	93	79	90·9	80·6	85·7	0·0	76·8	70	4·3	0	— 18	0*	...	...
Madras	1004·8	— 0·6	110	77	99·9	80·0	89·9	0·0	77·6	60	3·4	1	— 26	0*	...	...
Colombo, Ceylon	1008·6	+ 0·4	90	70	88·7	76·3	82·5	— 0·3	78·2	67	6·9	114	—197	15	8·9	72
Hong Kong	1008·9	— 0·5	90	68	82·6	74·2	78·4	+ 1·0	72·9	79	5·8	96	—201	13	7·6	58
Sandakan	...	...	90	74	88·4	75·8	82·1	— 0·5	†77·0	†79	...	140	— 12	9	...	...
Sydney	1012·2	— 6·4	85	45	71·0	54·4	62·7	+ 4·1	54·7	59	4·8	24	—108	5	5·5	53
Melbourne	1009·6	— 9·9	76	37	64·3	49·1	56·7	+ 2·6	51·8	67	6·4	50	— 5	20	4·2	42
Adelaide	1012·2	— 7·9	84	47	68·7	55·0	61·9	+ 4·1	55·7	66	7·4	119	+ 50	21	4·5	44
Perth, W. Australia	1015·2	— 3·6	76	45	69·0	55·4	62·2	+ 1·8	57·5	74	6·8	167	+ 48	23	4·3	41
Coolgardie	1015·2	— 4·6	84	38	70·6	47·3	58·9	+ 1·3	53·3	50	4·2	11	— 24	5	...	...
Brisbane	1015·1	— 3·7	90	51	78·7	56·2	67·5	+ 3·1	62·3	62	2·9	10	— 65	4	8·5	79
Hobart, Tasmania	1001·0	—14·6	69	34	57·4	44·2	50·8	+ 0·4	46·5	72	6·4	115	+ 68	25	4·5	46
Wellington, N.Z.	1009·9	— 5·3	67	37	59·5	48·2	53·9	+ 1·1	50·7	77	6·4	241	+121	21	3·3	33
Suva, Fiji	1011·8	— 1·0	83	66	80·0	70·7	75·3	— 1·2	72·2	84	6·1	189	— 69	17	...	...
Kingston, Jamaica	1012·4	— 0·9	89	67	86·3	73·3	79·8	+ 0·1	...	79	6·4	124	+ 14	11	...	...
Grenada, W.I.	1014·2	+ 1·6	87	72	85·4	74·8	80·1	+ 0·6	74·1	71	3·9	25	— 93	11	...	...
Toronto	1014·6	— 0·2	83	27	61·9	41·3	51·6	— 1·1	46·5	68	3·5	94	+ 18	10	...	...
Winnipeg	1013·6	— 0·7	90	19	67·3	41·5	54·4	+ 2·8	47·3	60	2·4	65	+ 8	7	...	...
St. John, N.B.	1013·2	— 0·8	73	33	55·4	39·7	47·5	— 0·2	43·5	79	6·2	65	— 29	11	...	...
Victoria, B.C.	1016·4	0·0	67	40	58·8	45·9	52·3	— 0·8	48·0	79	6·5	26	— 7	10	...	...

* For Indian stations a rain day is a day on which 0·1 in. (2·5 mm.) or more rain has fallen. † Mean of observations at 9h., 15h., 21h., from April, 1923.

Victoria, B.C.	1016·4	0·0	67	40	58·8	45·9	52·3	— 0·8	48·0	79	6·5	26	— 7	10	...	...

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